D5.3
Results on DSS ICT tool user's validation

LAB4SUPPLY project is part of the PRIMA programme supported by the European Union's Horizon 2020 research and innovation programme.

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Abstract
The present deliverable provides an overview of the DSS ICT tool developed in WP5, aimed at facilitating the farmer selection of alternative value chains for the commercialisation of its product, targeting crops and countries selected by the project.

Keywords
DSS tool, ITC, stakeholders, multi decision making, AHP

DISCLAIMER

Contents

1 Introduction on the Project

The project LAB4SUPPLY aims to provide solution to address the current difficulties of Mediterranean smallholders and traditional farmers, who face the main challenges that arise in the Agri-food value chain. LAB4SUPPLY offered viable solutions and opportunities to allow local smallholders to increase their competitiveness and profitability, using optimized Agri-food supply chain and improving adaptation capacity to unexpected market changes, which at the same time are better perceived by the consumers.

The Project has a consortium composed by Partners from 7 different countries in the Mediterranean area. They all have specialised profiles, such as advanced technological experience in ICT solutions, specialists in agri-food value chains and agroeconomics, specialist in consumer acceptance activities, agri-food products technologist, an international intergovernmental organisation. The consortium thus possesses in-depth knowledge of agricultural value chains, as well as an extensive technological capacity for the development of viable and exploitable solutions adapted to users.

LAB4SUPPLY addresses 5 case studies, 4 at country / territorial level, namely Tomato in Spain, Carob in Morocco, Goat in Algeria, Chestnut in France, and a common product at Mediterranean level, Figs in all the previously mentioned countries.

2 The ICT tool for identifying alternatives supply chains

There is a growing need to provide digital tools, easy to use and low cost, oriented to primary agri-food production and entrepreneurs to provide key indicators for decision making on alternative value chains. For this sake, in the LAB4SUPPLY project the design and implementation of a decision support system tool, DSS ICT tool addressed to smallholders, simulating alternative added-value channels for agricultural products is foreseen.

In this context, the main idea is first to understand factors affecting farmers' decisions to select their current Distribution Channel through the interviews and questionnaires (WP1) and farmers' objectives. These factors will be the basis of the creation of the compiled data to understand the current *status quo* (reference scenarios). An example of an initial scenario for tomato could be as follows:

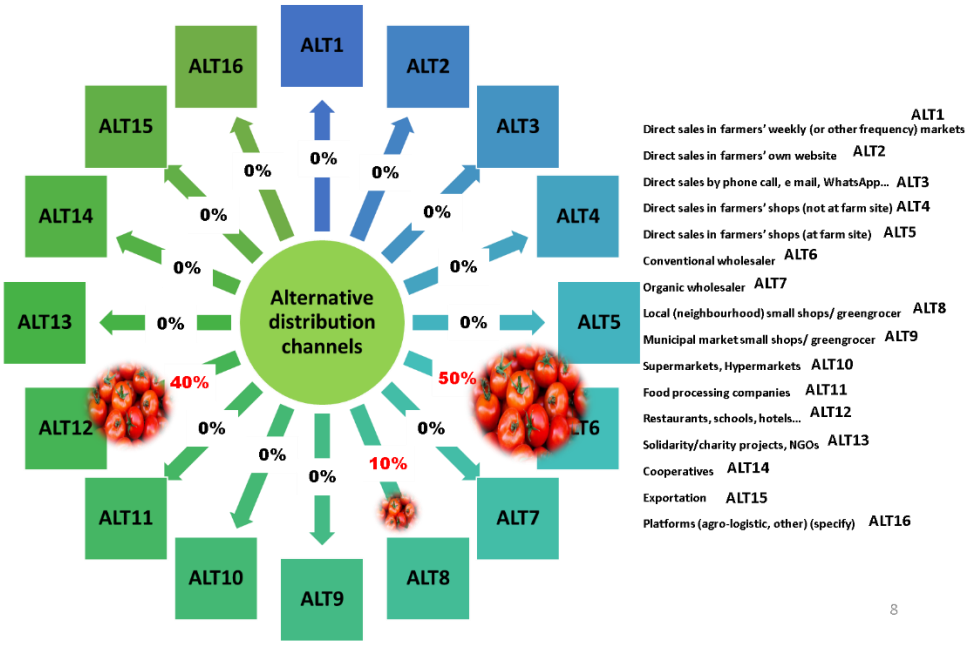


Figure 1: Current scenarios of supply chain combination (tomato case study)

Secondly, on the basis of the identified sustainability indicators and the evaluation made in the 5 LAB4SUPPLY agri-food supply chains (WP2), and the outcome from the Focus groups within each Living Lab (WP3), a simulated supply chain combination (simulated scenario) is proposed as follows:

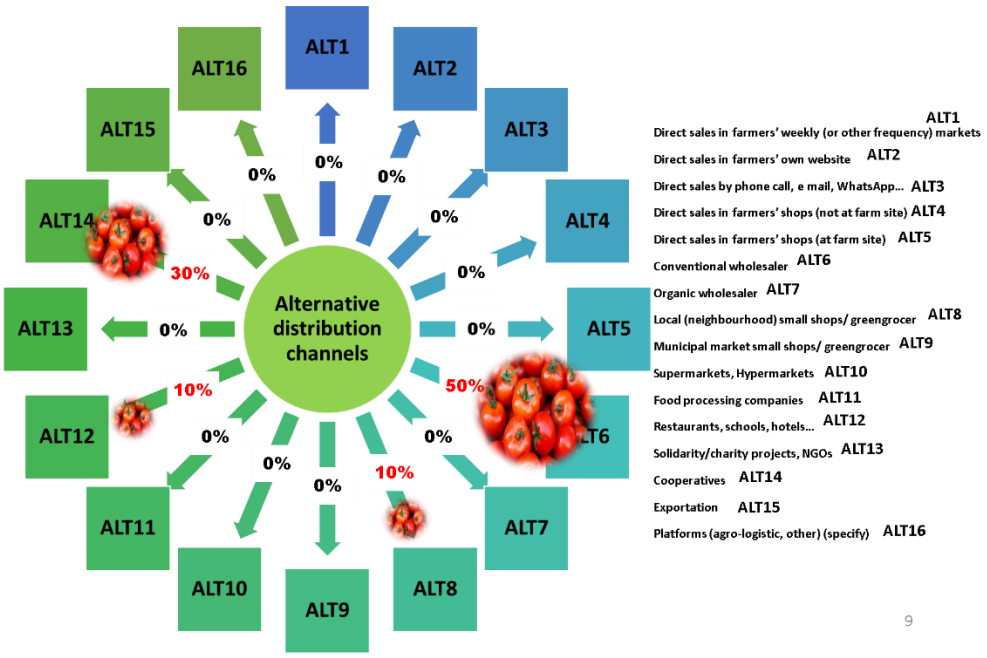


Figure 2: Simulated scenario proposed by taking into account the sustainability indicators (tomato case study)

2.1 Overview

The tool is implemented as a web application provided as service by the Horta IT infrastructure. The service workflow has three steps:

1. Initialize a new computation providing the initial attributes
2. Data entry regarding the information required by the algorithm
3. Results computed on the input data

Each group of the entered data and related results is called "*simulation*" and, each *of them* is referred to:

1. A user (the owner of the simulation)
2. A product (chosen by the list defined by the ADMIN)
3. Four domains of sustainability: Economic, Environmental, Social and Governance
4. Five indicators for each domain of sustainability
5. Eight sales channels, that need to be selected form the list defined by the ADMIN.

According to the algorithm provided by CREDA, the result of the calculation procedure is the percentage of product to be allocated to each of the eight selected sales channels

in order to satisfy the user needs in term of sustainability, set by the comparisons among domains and indicators per domain.

An example of results is shown below:

Type Of Sales Channels	Sales Channels	Simulation Results
e-commerce	Direct sales by phone call, e mail, WhatsApp...	26.76%
Direct Sales	Direct sales in farmers' weekly (or other frequency) markets	12.60%
Industry	Food processing companies	12.31%
Direct Sales	Direct sales in farmers' shops (at farm site)	11.95%
Small retailer	Municipal market small shops/ greengrocer	11.64%
Small retailer	Local (neighbourhood) small shops/ greengrocer	9.74%
Wholesaler	Conventional wholesaler	7.60%
Supermarkets	Supermarkets, Hypermarkets	7.40%

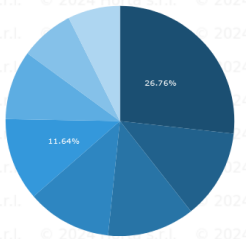


Figure 3: Results of one simulation as provided in the IT tool developed

2.1.1 Access

The tool access requires the user authentication, which can be made inserting personal credentials at Horta's *Reserved area* access page (https://www.horta-srl.it/en/area-riservata-2/). Credential are provided to project partners by the Horta staff upon request.

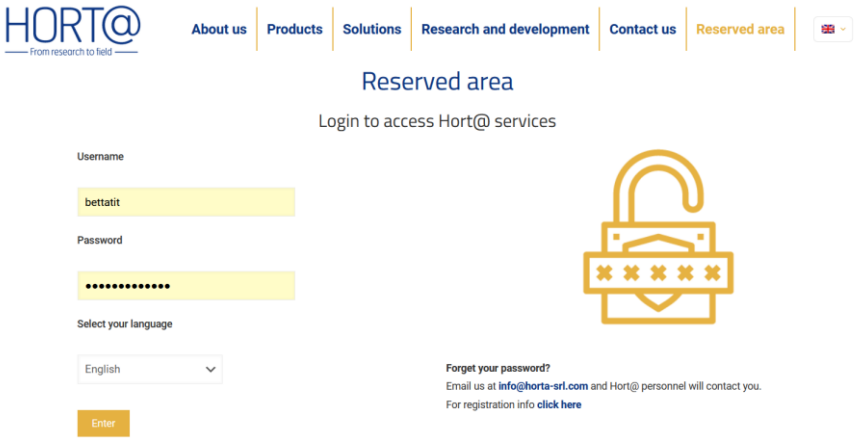


Figure 4: Authentication page in the Horta website

2.1.2 Roles and options

The Lab4Supply service is designed for two users type:

1. Administrator (ADMIN): this role allows to access all the simulations made by any of the users. Admins can view and modify simulations started form other users, but cannot delete them. Moreover, the ADMIN can manage the tables listing the products, sales channels and type of channels, being thus allowed to modify the existing data, or to add new options in each of the list.

2. User: this role allows to access only own simulations, which can be visualised, modified or deleted.

An extra option allowing to view intermediate calculation results (debug mode) can be configured to Admins upon request.

2.1.3 Credentials

The credentials to access the IT tool (username and password) need to be requested to the Horta's project contact (v.manstrett@horta-srl.com) providing:

1. name and surname
2. valid email address

and, optionally, the role request (user will be the default) and the extra-options required (no extra-options will be the default)

The credential will be sent to the user via e-mail by the Horta staff.

2.2 Use of the Lab4Supply IT tool

2.2.1 The main toolbar

Common to all the service's pages it provides the icons to navigate between the service's main pages according to the user role:

Icon	Description	Roles
	Opens the Lab4Supply home page	User, ADMIN
	Opens the list of products page	ADMIN
	Opens the list of sales channels page	ADMIN
	Opens the list of channels type page	ADMIN

2.2.2 The home page

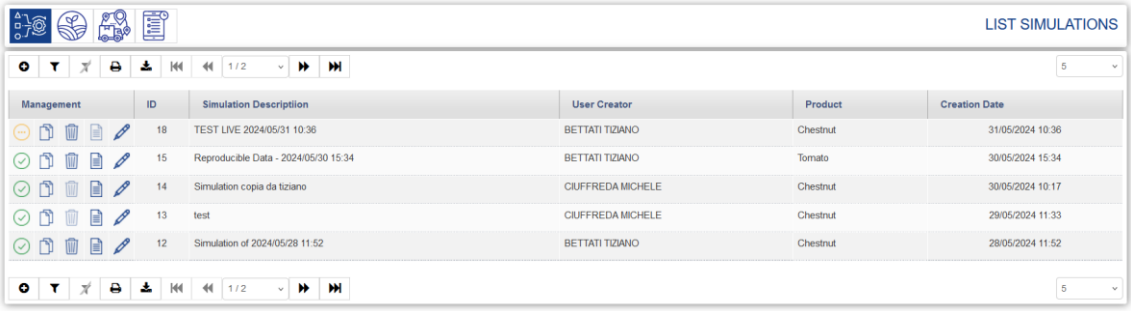


Figure 5: Homepage in the Lab4Supply IT tool

Below the main toolbar, the page provides a table showing the simulations by row. According to the user/ADMIM role, it is possible to visualise only own or all the simulations.

The table has its own toolbar, allowing to perform actions on the table. A set of icons is also available in each row, allowing to perform actions on the simulation.

Setup of a new simulation

A new simulation can be initialised by clicking the icon "*plus*" of the table toolbar.

Input request is opened in a new page, where the user is requested to provide information on three attributes. All the attributes are mandatory, as shown by the presence of a red bullet point after the attribute label.

Figure 6: Initialisation of a new simulation in the Lab4Supply IT tool

Attribute	Description

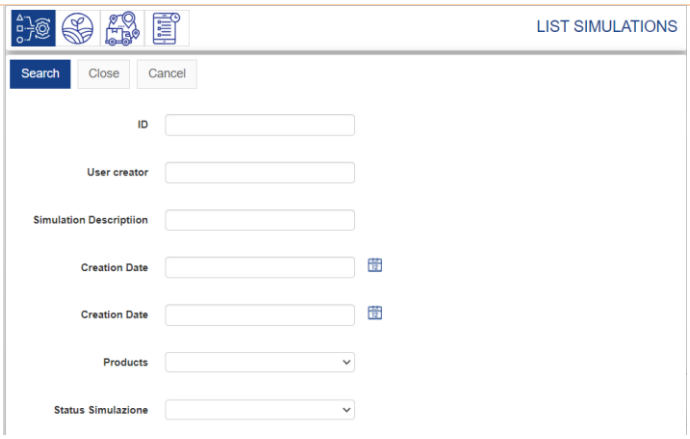
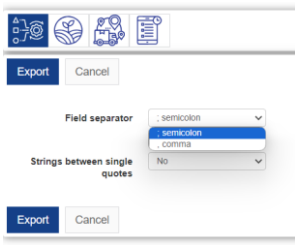
Simulation description	It is the simulation label. A default label is provided automatically, but is customizable by the user.
Products	A pull-down menu allows the user to choose the product object of the simulation.
Sales channels	A pull-down menu allows the user to select eight (mandatory) sale channels choosing from the list defined at ADMIN level. Note that a channel inserted can be excluded clicking the (X) icon on the left of is label (Ref. Image below)

Figure 7: Selection of the sales channels in the Lab4Supply IT tool

By clicking the 'Save and go Next' button, the simulation is initialized and the data entry procedure is started.

Other actions on the "simulation table"

Actions	Description
Apply filter: On|Off	The icon "*filter*" opens a page allowing to configure the filtering criteria as shown below:

	 When a filter is applied the "*un-filter*" icon becomes available.
Print table	Allow to print the simulation list table.
Download the table as CSV	The table as CSV file is exported choosing some options from a box.  The CSV exports also the sales channels selected, so it has eight rows per simulation.
Navigation buttons	The buttons first, previous, next and last page allow the user to navigate the table.
Change the number of rows	A drop-down menu allows the user to change the number of rows shown by each table page.

Information and action per simulation

Each row of the table is referred to a simulation, so the row's icons allow the user to get information or perform selected actions on the specific simulation.

Object	Description
Icon status	This is the first icon from the left, which can assume two status as shown below:

	 • Orange circle with dots: Simulation not completely compiled. Results NOT available. • Green circle with tick: Simulation compiled and results available.
Icon duplicate	Duplicate the simulation to new-one.
Icon trash	Cancel the simulation.
Icon sheet	Go to the results page of the simulation (not available for non-completed simulation).
Icon pencil	Explore the simulation in edit mode.
Text columns	Others five text columns provide additional information regarding the simulation: Simulation ID; Simulation description; User creator; Product; Creation date.

2.2.3 Sales product page

This section is reserved to the ADMIN roles, and it allows to change the name of the product available or to insert new ones, which then becomes available for the user.

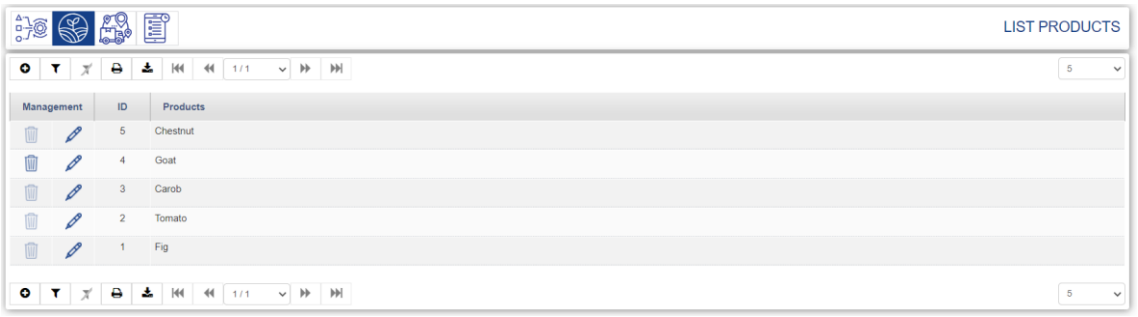


Figure 8: Management options of the products in the Lab4Supply IT tool

As explained for tables in previous section, the table has its own toolbar, allowing to perform actions on the table, and icons are also available in each row, allowing to perform actions on the products.

It is possible to insert a new product clicking on the “plus” icon of the table toolbar, while it is possible to change the name of a product clicking on the pencil icon. It is possible to eliminate products using the trash icons, but the action is allowed only if there is no related simulation.

2.2.4 Sales channels

This section is reserved to the ADMIN roles, and it allows to change the name of the sales channels available or to insert new ones, which then becomes available for the user.

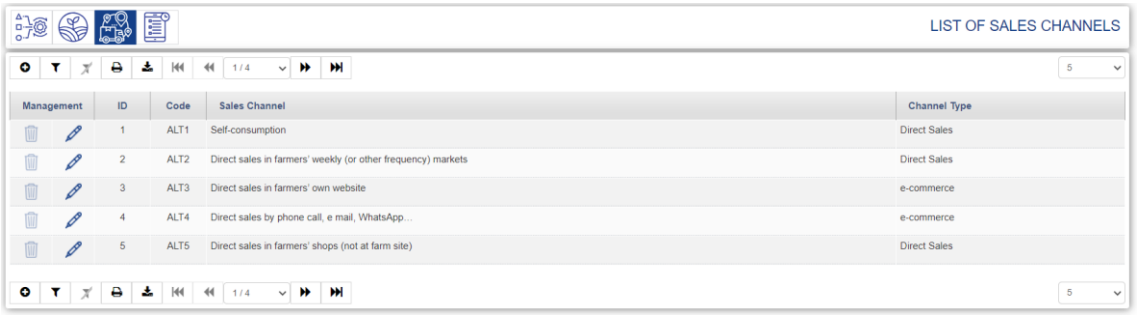


Figure 9: Management options of the sales channels in the Lab4Supply IT tool

As explained for tables in previous section, the table has its own toolbar, allowing to perform actions on the table, and icons are also available in each row, allowing to perform actions on the sales channels.

It is possible to insert a new sale channel clicking on the "plus" icon of the table toolbar, while it is possible to change the name of a sale channel clicking on the pencil icon. Each channel needs to be classified by a type.

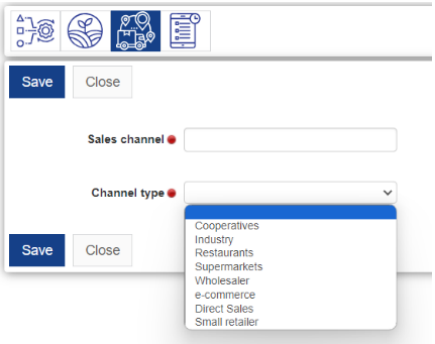


Figure 10: Management options of the sales channels in the Lab4Supply IT tool

It is possible to eliminate sale channel using the trash icons, but the action is allowed only if there is no related simulation.

2.2.5 Channels type

This section is reserved to the ADMIN roles, and it allows to change the name of the Channel type or to insert new ones, which then becomes available for the user.

Figure 11: Management options of the channel type in the Lab4Supply IT tool

As explained for tables in previous section, the table has its own toolbar, allowing to perform actions on the table, and icons are also available in each row, allowing to perform actions on the sales channels.

It is possible to insert a new channel type clicking on the "plus" icon of the table toolbar, while it is possible to change the name of a channel type clicking on the pencil icon. It is possible to eliminate a channel type using the trash icons, but the action is allowed only if there is no related simulation.

2.2.6 Setup a new simulation

As introduced in previous sections, the plus icon (+) of the simulation table starts the procedure for a new simulation.

After the first step inserting the first three simulation attributes (see section 2.2.2) the service starts a wizard-based user interface that guides the user filling pair comparisons between all the procedure elements, using a score based subjective evaluation.

- Diagonal matrix-based user interfaces allow to perform the pairwise comparisons, assigning the score using a scale from 1 to 9.

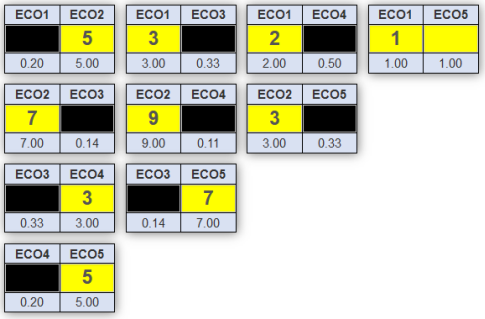


Figure 12: Diagonal matrix-based user interface in the Lab4Supply IT tool

- For each pairwise comparison, only one of two cells can be filled in, except when the value 1 is assigned, in which case the system allows to enter a value in both

cells. The scale to be used for pairwise comparison is always reported next to the diagonal matrix, as well as the meaning of the items that are being compared.

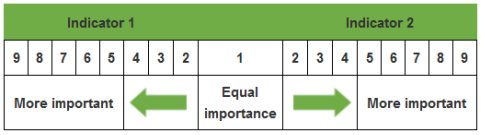


Figure 13: Scale to be used for the pairwise comparisons in the Lab4Supply IT tool

Data input by the user in the IT tool is organised according to the following hierarchical order:

2.2.6.1 Groups of indicators (domains)

A three columns diagonal matrix allows the user to insert the relative importance between the four groups of indicators (domains), always by mean of pairwise comparisons.

A Consistency Ratio (CR) is computed at the end of the data entry in each diagonal matrix. An internal control verifies if the CR exceed the value of 10%, the simulation cannot be accepted. An error message is then shown to the user, which is required to revise the input data.

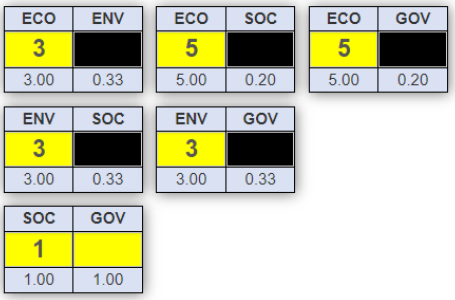


Figure 14: Diagonal matrix for pairwise comparisons of sustainability domains

2.2.6.2 Indicators in each sustainability domain

A four columns diagonal matrix allows the user to make pairwise comparisons among indicators in the same sustainability domain, thus stating their relative importance. Next to the matrix, the 1-9 scale for rating and the full name of the indicators being compared is displayed to the user. A matrix is provided for each sustainability domain (Economic, Environmental, Social, Governance).

For this matrix a Consistency Ratio is computed. If exceed the value of 10% the imputations can't be accepted.

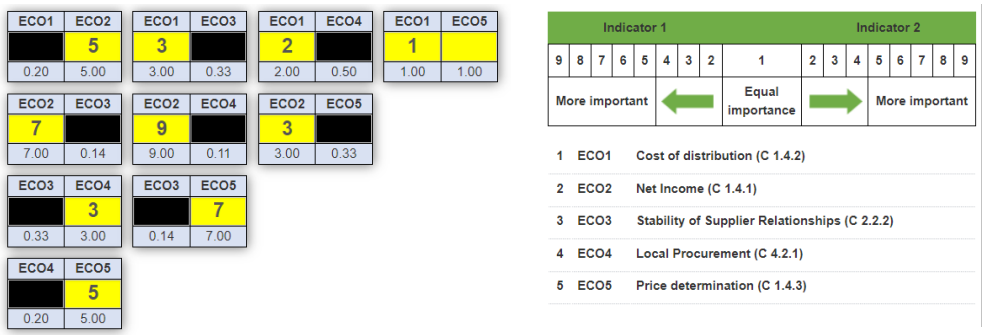


Figure 15: Diagonal matrix for pairwise comparisons of economic indicators, the scale and indicators reminder

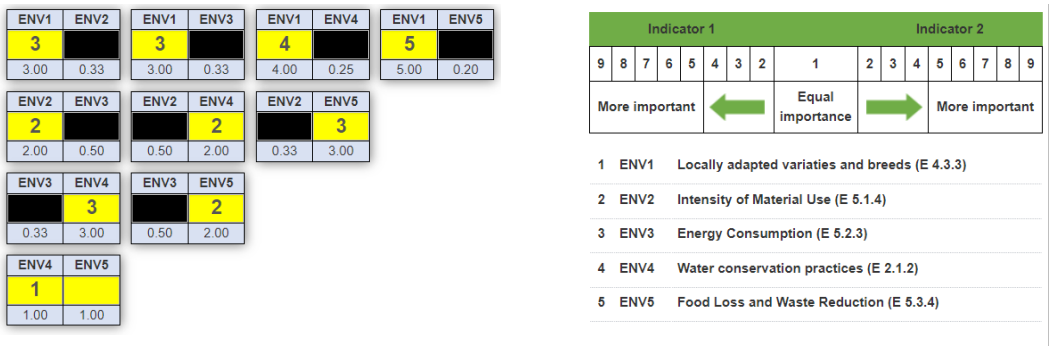


Figure 16: Diagonal matrix for pairwise comparisons of environmental indicators, the scale and indicators reminder

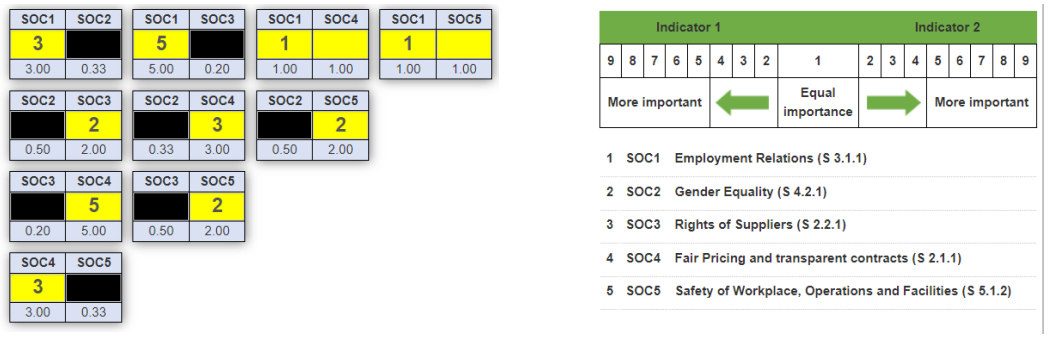


Figure 17: Diagonal matrix for pairwise comparisons of social indicators, the scale and indicators reminder

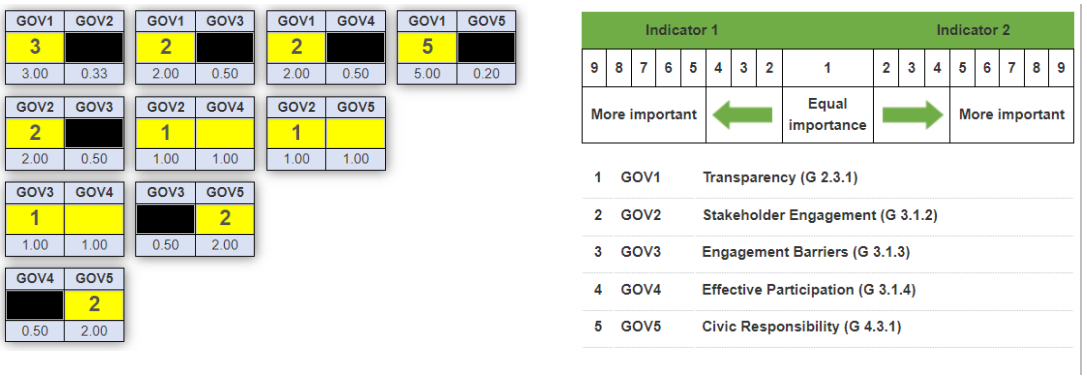


Figure 18: Diagonal matrix for pairwise comparisons of governance indicators, the scale and indicators reminder

2.2.6.3 Channels intra indicators

After having set the relative importance of sustainability domains and indicators in each domain, the user is requested to rate commercialisation alternatives. The rating is done by mean of pairwise comparisons, and alternatives are confronted for each indicator in each sustainability domain. In order to do so, the IT tool provides a seven columns diagonal matrix allowing to insert the relative importance between the eight selected channels, for each indicator in each domain.

Below two examples of this pages:

1. ECO-ECO1 indicator
2. ENV-ENV3 indicator

Figure 19: Diagonal matrix for pairwise comparisons of alternative in the view of indicator ECO1, the scale and alternatives reminder

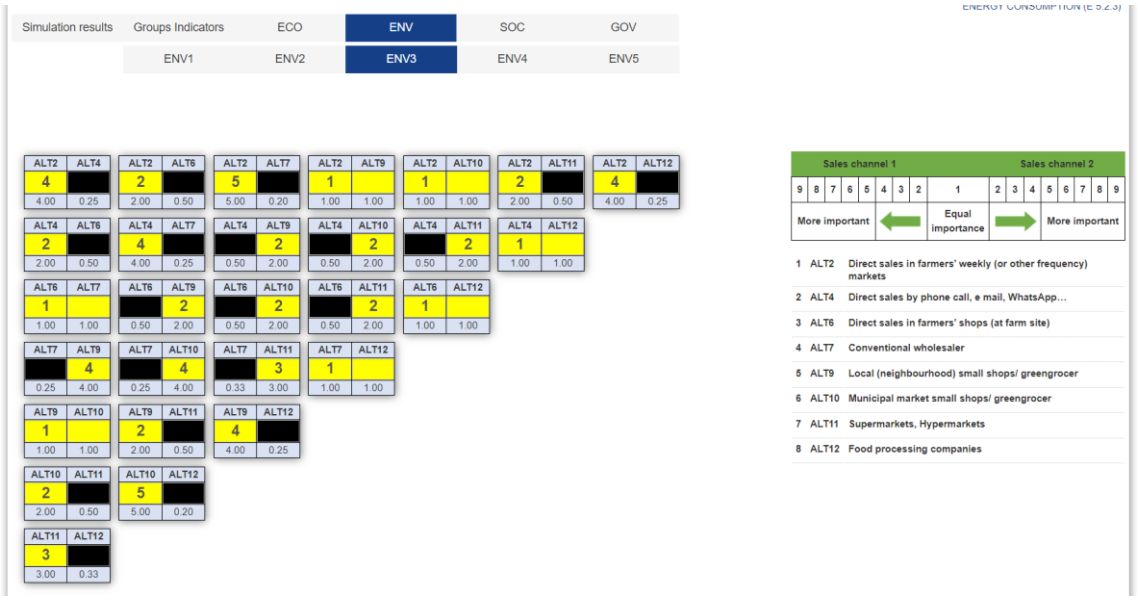


Figure 20: Diagonal matrix for pairwise comparisons of alternative in the view of indicator ENV3, the scale and alternatives reminder

2.2.6.4 Notes

As the data entry operation can take a great amount of time, the service saves on the database the advancement at each page change. This allows the user to split the data-entry phase in several sessions, avoiding the risk of losing information.

2.2.7 Results page

After compiling the diagonal matrix for the last domain-indicators context (GOV-GOV5), the service provides the user the result page. The results provided are the list of the eight sales channels ordered by the percentage of product recommended for each channel according to the sustainability goals of the user, set by mean of the pairwise comparisons entered in the data entry phase. Results are shown both in a table, on the left side of the screen, and on a pie chart, on the right of the screen. The pie chart provides the graphical representation of the relative percentage of product recommended for each commercialisation alternative.

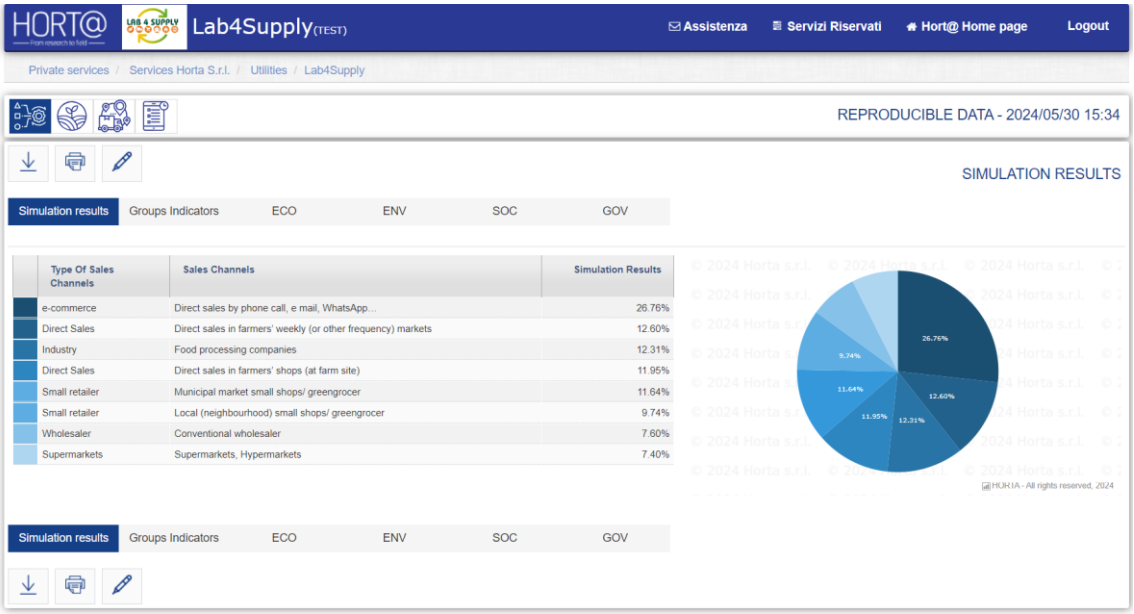


Figure 21: Simulation result page in the Lab4Supply IT tool

2.2.7.1 Export the results

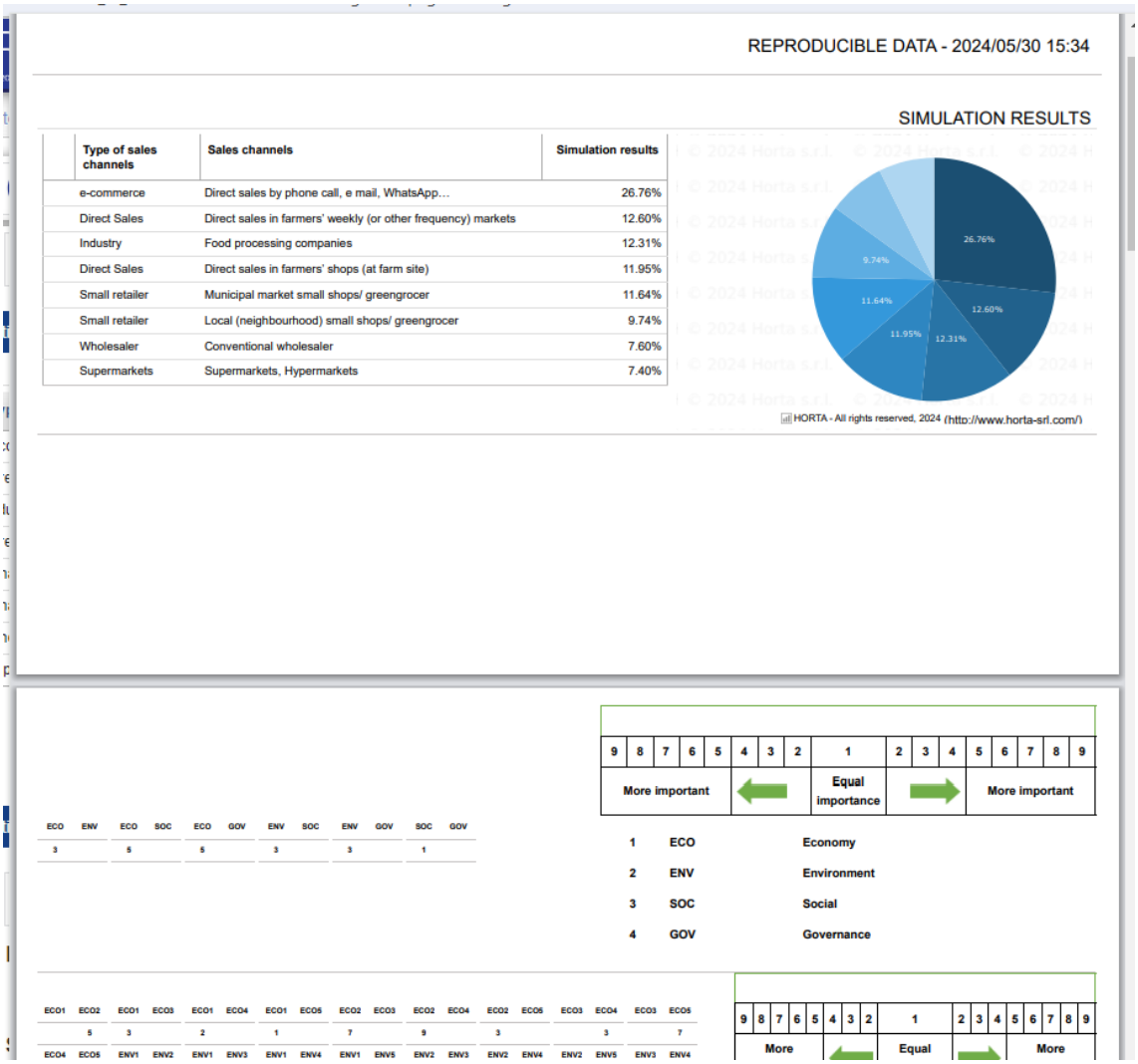
The user can export the results of the simulation using the icon download (down arrow). This operation allows to export the results table in a multi-sheet XLSX file, constituted by a sheet for the main results table, and others six sheets reporting the input entered for this simulation.

2.2.7.2 Modify the data

The icon pencil allows the user to enter each page to check and adjust the relative importance scores already inserted. In the case data are modified, results are re-calculated on run time at the opening of the results page.

2.2.7.3 Print the page

The print function (icon printer) generates a multi-page document providing the main results page and detailed page regarding the input entered for the simulation.



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SIMULATION RESULTS

Type of sales channels	Sales channels	Simulation results
e-commerce	Direct sales by phone call, e mail, WhatsApp...	26.76%
Direct Sales	Direct sales in farmers' weekly (or other frequency) markets	12.60%
Industry	Food processing companies	12.31%
Direct Sales	Direct sales in farmers' shops (at farm site)	11.95%
Small retailer	Municipal market small shops/ greengrocer	11.64%
Small retailer	Local (neighbourhood) small shops/ greengrocer	9.74%
Wholesaler	Conventional wholesaler	7.60%
Supermarkets	Supermarkets, Hypermarkets	7.40%

ECO	ENV	ECO	SOC	ECO	GOV	ENV	SOC	ENV	GOV	SOC	GOV
3		5		5		3		3		1	

9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
More important								Equal importance				More important				

1	ECO	Economy
2	ENV	Environment
3	SOC	Social
4	GOV	Governance

ECO1	ECO2	ECO1	ECO3	ECO1	ECO4	ECO1	ECO5	ECO2	ECO3	ECO2	ECO4	ECO2	ECO5	ECO3	ECO4	ECO3	ECO5
	5		3		2		1		7		9		3		3		7
ECO4	ECO5	ENV1	ENV2	ENV1	ENV3	ENV1	ENV4	ENV1	ENV5	ENV2	ENV3	ENV2	ENV4	ENV2	ENV5	ENV3	ENV4

9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
More								Equal				More				

Figure 22: Export document obtained by the Lab4Supply IT tool

3 Testing the tool

The tool was presented to project partners during the final meeting of the LAB4SUPPLY project held on the 30 and 31 May 2024 at CREDA premises in Castelldefels, Barcelona, Spain.

During the meeting, the tool was illustrated to all project partners, which were also provided with credentials for accessing the tool. Addresses were collected in the following days, and username and passwords were provided. As the scope of the tool was modified since the project beginning, and the developed tool was aimed for research, teaching and consultation purposes, the test with farmers was not more in line with the project scope.

CREDA was the first partner to test the tool, researchers were provided with accounts able to access the tool in debug mode, so that they could verify calculation intermediate steps. The comments received highlight that the DSS Tool is derived from the provided Excel tool and follows the Analytical Hierarchy Process (AHP) methodology. It is crucial to adhere to two key principles: conducting paired comparisons of all elements and ensuring the consistency of the results.

In relation to the first criterion, it has been noted that the proposed tool consistently requires a pairwise comparison of its elements, assigning values to the right or left in each instance, thereby satisfying the first principle.

In relation to the second criterion, the Consistency Ratio (CR), it is recommended that it should not surpass 10% in order to deem the matrix as consistent. It has been noted that when reloading the data, the comparison of indicator groups and individual indicators consistently shows the value of the CR. However, this is not the case when filling in the sales channels comparison matrix. The comment has been addressed from Horta technicians, in order to solve it.

After conducting multiple tests on the tool to validate its application from the perspective of potential users (researchers), it has been confirmed that the tool adheres to the AHP methodology proposed as the foundation of this application.

The following recommendations are suggested to enhance its presentation for future users.

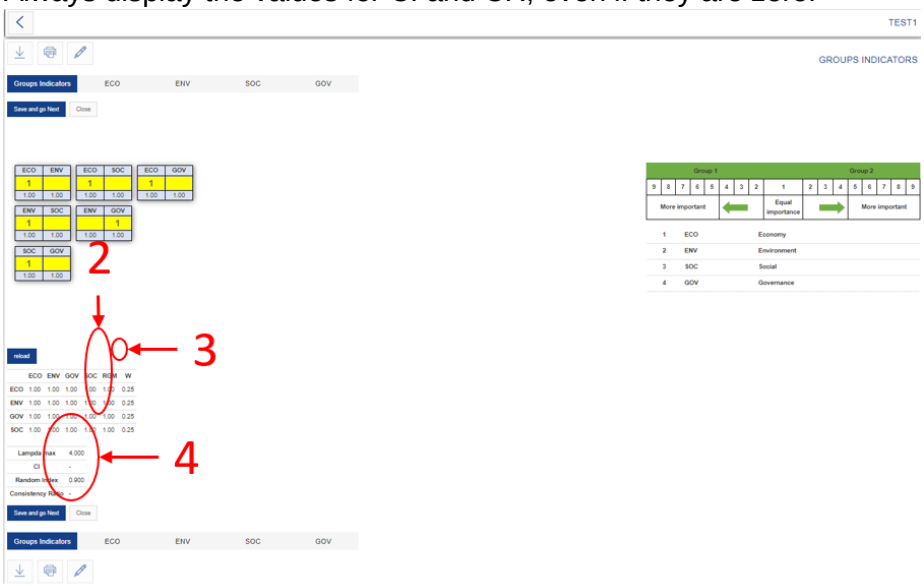
1. To enhance the tool's versatility, it is recommended to include "other" in the list of products and sales channels.
   Reply: The comment has been addressed by Horta, and the ‘Other options were entered. It is anyway worth to point out that users with ad Administration profile can add and modify lists on their own, so that they can perform simulations stating their products and channels.

The comparison interface offers some suggestions:

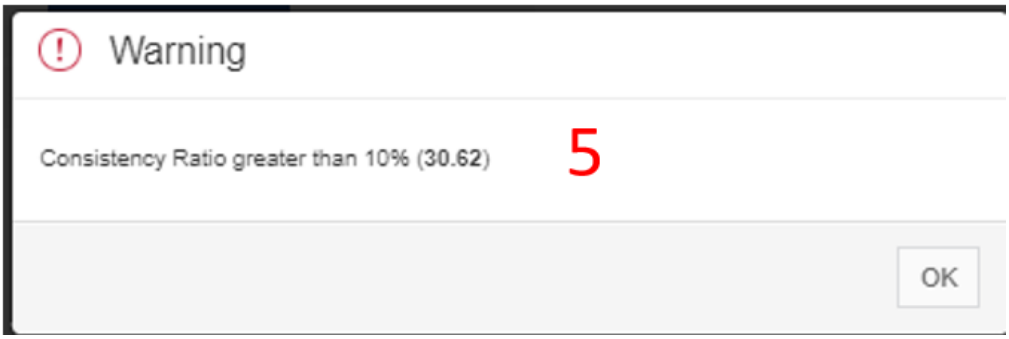
2. Exclude the column associated with the geometric mean (RGM) since it is required for the calculation but lacks utility for the user.

3. Substitute the letter W with Relative Importance, denoting the values in percentage.

4. Always display the values for CI and CR, even if they are zero.

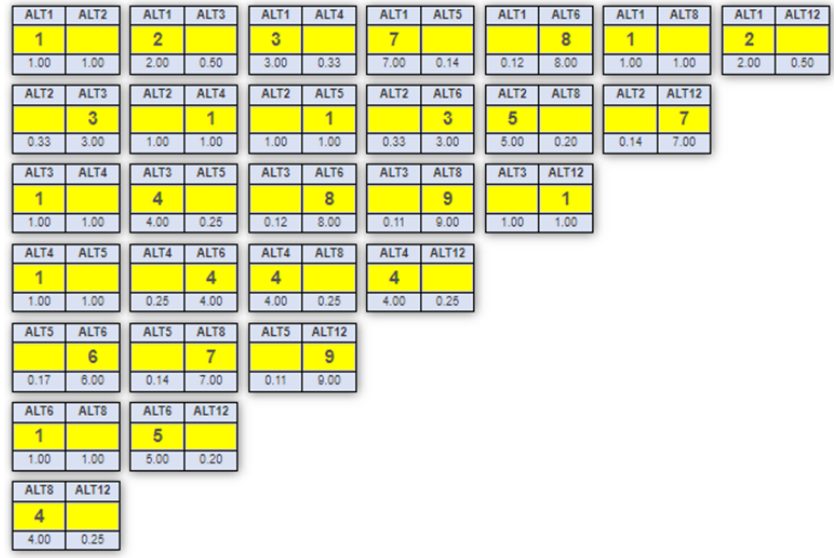


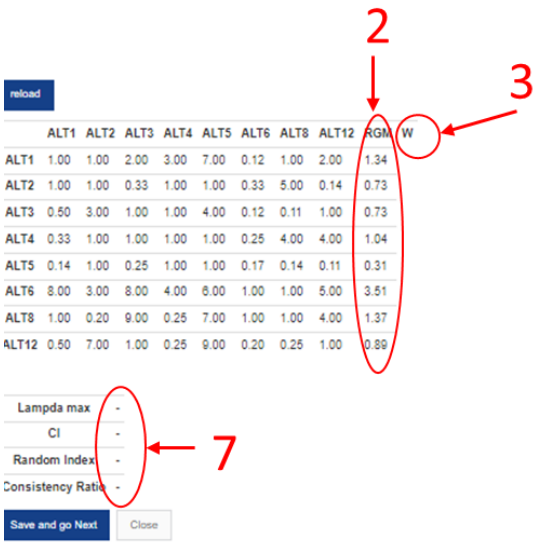
5. Include the sentence "Please correct your answers" in the alert message.



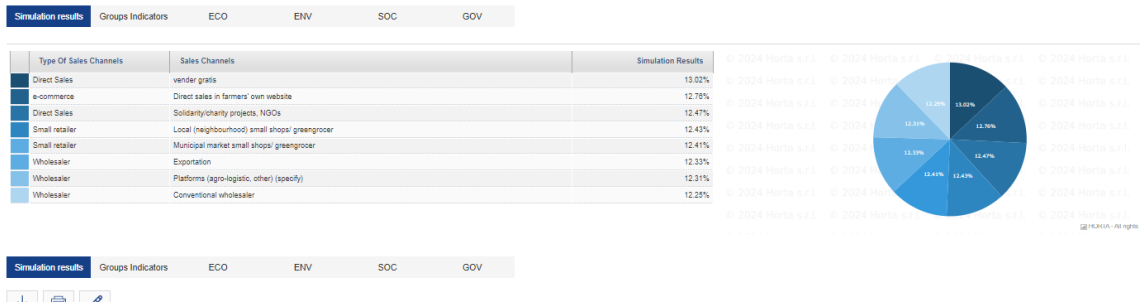
6. Integrate the CI and CR values into the analysis of sales channels, remove the RGM column, and compute the values in the W (Relative Importance) column.

7. Include the requirement that all matrices must have a Consistency Ratio lower than 10%.





8. It is recommended to include a graph in the simulation of the results that displays the performance of the groups and indicators, in addition to the sales channels.



Comment n. 1 has been addressed by Horta, and the 'Other' options were entered. It is anyway worth to point out that users with ad Administration profile can add and modify lists on their own, so that they can perform simulations stating their products and channels.
Comment n. 2 is referred to a table visible only to users with the 'debug' mode activated, as it is useful for the verification of the calculations performed by the tool. Therefore, the comment is not relevant for users with a basic profile, that are not allowed to see access this intermediate results display.
Comments from 3 to 8 have been received from Horta, and are being evaluated to be addressed in a future development of the IT tool. It is noted that the above comments can improve the tool usability from the user. Graphs proposed in comment 8 will help the user to get knowledge on the relative importance stated for the sustainability dimensions and indicators.

4 Conclusion

The present deliverable presents the LAB4SUPPLY DSS ICT tool, which has been developed as an online service. In agreement with project partners, the tool is based on the Analytical Hierarchy Process (AHP) method, as a multicriteria decision method following a holistic approach to sustainability. CREDA has provided the algorithms to be implemented in the IT tool, in form of an excel file. The primary objective of this tool is to cater to needs of researchers, particularly in the context teaching and consultancy activities. From the focus group discussions with farmers, it has become evident that incorporating an IT tool into their already demanding schedules would prove to be an overly burdensome task. The tool guides the user in the pairwise comparisons that are need by the selected methodology to define sustainability goals, and then displays the final results, which state the relative amount of product that needs to be commercialised in each of the selected sales channels, in order to meet the sustainability goals, set by the user, considering all the four dimensions of sustainability (economic, environmental, social and governance).